生物策略表

類別	生物策略 (Strategy)
生物策略 STRATEGY	消化系統性能最佳化 (Digestive system optimizes performance)
生物系統 LIVING SYSTEM	緬甸蟒 *Python bivittatus* (Burmese python)
功能類別 FUNCTIONS	#改變材料特性 #形狀/材料最佳化 #調節細胞代謝過程 #Modify material characteristics #Optimize shape/materials #Regulate cellular processes
作用機制標題	緬甸蟒蛇的胃腸道系統由於細胞可塑性，能夠快速調節空腹和攝食之間的性能（使節省能量） (The gastrointestinal system in burmese pythons quickly regulates performance between fasting and feeding [leading to energy savings] thanks to cell plasticity.)
生物系統/作用機制示意圖	

作用機制摘要說明 (SUMMARY OF FUNCTIONING MECHANISMS)

文獻引用 (REFERENCES)

「緬甸蟒蛇消化系統在空腹 (fasting) 和重新進食 (refed) 的形態，以及質子泵 (H^+、K^+-ATPase) 和鈉離子泵 (Na^+、K^+-ATPase) 的位置已被確定。在空腹狀態中的蛇，位於胃底腺 (fundic gland) 內的產酸酶原細胞 (oxyntopeptic cell) 通常不活躍，具有厚厚的頂端管狀小泡系統和大量的酶原顆粒 (zymogen granules)。它們在進食后立即變得活躍，但在進食獵物 3 天后即返回非活躍狀態。質子泵在不同的空腹/進食狀態中均有表現，不是被隔離在非活性細胞的管狀小泡系統中，就是沿著活性細胞中小囊內腔內延的頂端指突分佈。鈉離子泵在進食後迅速上調，並位於產酸酶原細胞的基底外側膜上。在腸道中只沿著腸細胞的側膜表現，即在側面空間的上方，而不是沿著細胞的基底側表現。因此，腸道內膜中溶質的運輸主要是透過細胞的頂端部分和側面空間達成；而吸收的脂肪則大量穿過細胞的整體高度，並流入細胞間隙。因為透過低成本的細胞變化、被動機制以及鈉泵等關鍵酶的逐漸啟動和合成，所以緬甸蟒的胃腸道細胞系統在進食后可迅速向上調節。這種細胞可塑性還可以預測下一個空腹和進食週期。」 (Helmstetter et al. 2009: 632)

"The morphology of the digestive system in fasting and refed Burmese pythons was determined, as well as the localization of the proton (H^+, K^+-ATPase) and sodium (Na^+ ,K^+-

ATPase) pumps. In fasting pythons, oxyntopeptic cells located within the fundic glands are typically non-active, with a thick apical tubulovesicular system and numerous zymogen granules. They become active immediately after feeding but return to a non-active state 3 days after the ingestion of the prey. The proton pump, expressed throughout the different fasting/feeding states, is either sequestered in the tubulovesicular system in non-active cells or located along the apical digitations extending within the crypt lumen in active cells. The sodium pump is rapidly upregulated in fed animals and is classically located along the baso-lateral membranes of the gastric oxyntopeptic cells. In the intestine, it is only expressed along the lateral membranes of the enterocytes, i.e., above the lateral spaces and not along the basal side of the cells. Thus, solute transport within the intestinal lining is mainly achieved through the apical part of the cells and across the lateral spaces while absorbed fat massively crosses the entire height of the cells and flows into the intercellular spaces. Therefore, in the Burmese python, the gastrointestinal cellular system quickly upregulates after feeding, due to inexpensive cellular changes, passive mechanisms, and the progressive activation and synthesis of key enzymes such as the sodium pump. This cell plasticity also allows anticipation of the next fasting and feeding periods." (Helmstetter et al. 2009: 632)

參考文獻清單與連結 (REFERENCE LIST)

Helmstetter, C., N. Reix, M. t'Flachebba, R. K. Pope, S. M. Secor, Y. Le Maho, and J. H. Lignot. (2009). Functional changes with feeding in the gastro-intestinal epithelia of the Burmese python (*Python molurus*). *Zoological science* 26: 632-638. (https://doi.org/10.2108/zsj.26.632)

延伸閱讀: Harvard 或 APA 格式

生物系統延伸資訊連結 (LEARN MORE ABOUT THE LIVING SYSTEM/S)

https://en.wikipedia.org/wiki/Python_molurus

撰寫/翻譯/編修者與日期

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AskNature 原文連結

https://asknature.org/strategy/digestive-system-optimizes-performance/